



RFL Communications plc



Utility Network Specialists

SMX3 / 21 Sub-MUX

X.21 / V.24 Dual-Protocol sub-rate multiplexer

User Manual

Issue 1.4

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Issue	Comments	Date
1.0	Draft issue	19 February 2009
1.2	Initial Release Applicable Firmware release smx-2-1-0-1.mcs	04 March 2009
1.3	Example configurations added, timing details expanded	07 May 2009
1.4	Loopback schematics added	08 June 2009

1. Introduction

Prompted by SP Powersystems' operational requirements in the former MANWEB region, RFL developed a four channel sub-multiplexer to support operation of their MPR – LZPK102 protection relays and SCADA systems over leased digital circuits. The requirements for this multiplexer is described in SMX3/40 Sub-MUX X.21 High speed sub-rate multiplexer User Manual Release 2.01.

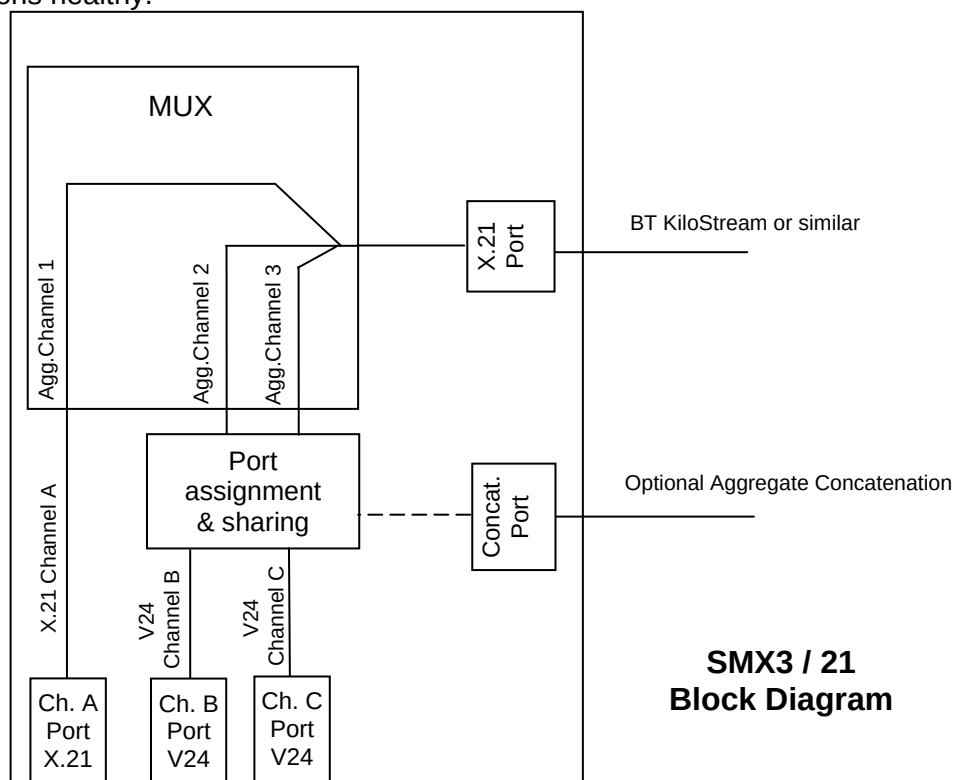
This new Dual-Protocol version, SMX3/21, is designed to support protection relays with an X.21 serial interface rather than a V.24 interface, together with two V.24 channels (typically used for RS232) that can be used for the existing SCADA equipment.

2. Features

The RFL SMX3/21 Sub-MUX is a hardened (EATS 48-5) sub-rate multiplexer. The equipment is 19" rack mountable, 1U high, with reversible mounting brackets permitting either the connectors or the LEDs to face the front of the rack.

SMX3/21 aggregates one X.21 data channel (Channel A) and two V.24 data channels (Channel B & Channel C) across a single point to point X.21 service. Data Channel A is permanently allocated to Aggregate Channel 1. The V.24 Data Channels B and C may both be assigned to either Aggregate Channel 2 or Aggregate Channel 3. Both V.24 channels may be assigned to a single aggregate channel; this feature is useful for supporting SCADA systems where multiple terminals are attached.

LEDs are provided for Power Supply healthy and for the status of all ports. Two volt free alarm changeover contacts are provided for Power and Aggregate Communications healthy.

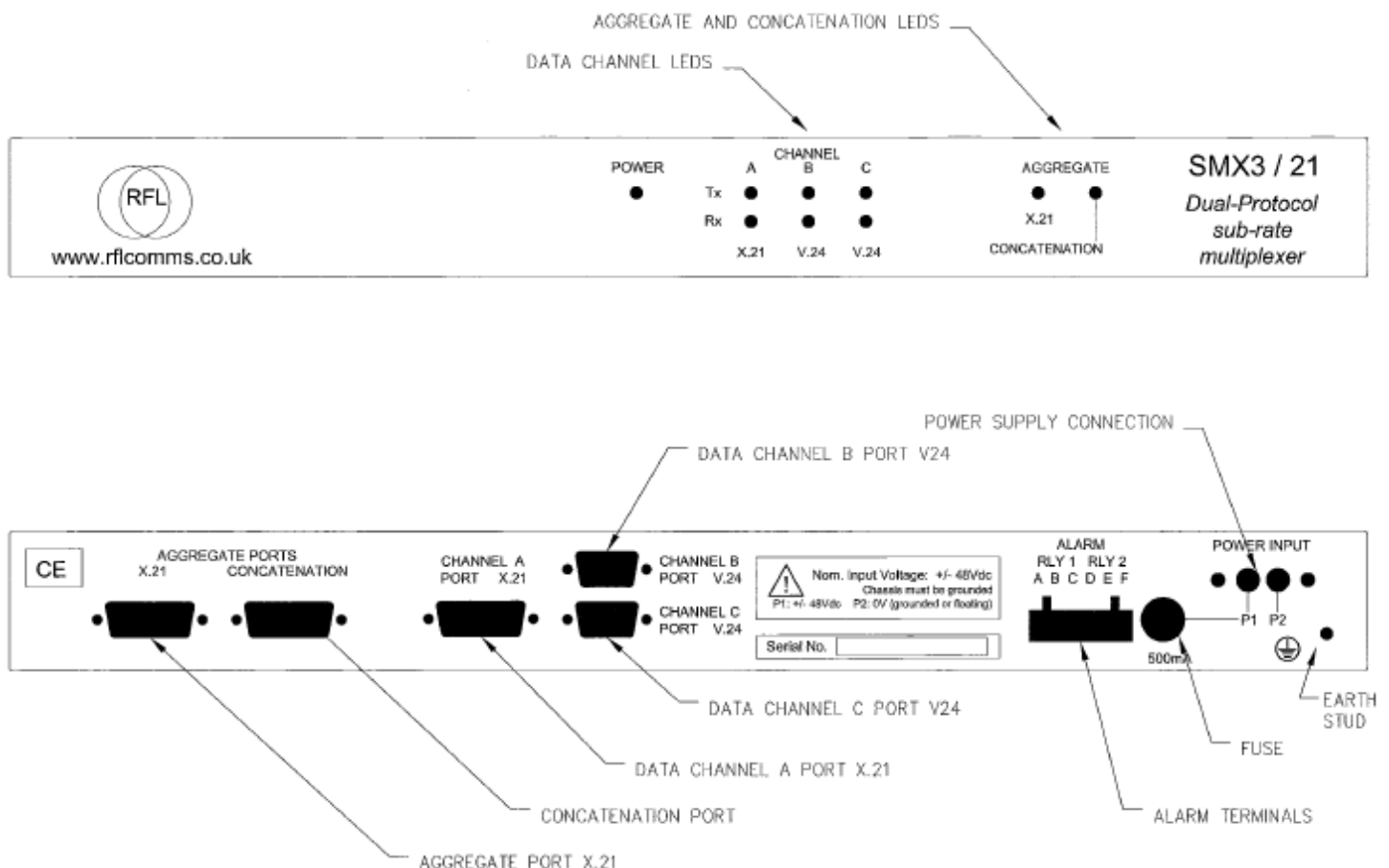


3. Concatenation and Network Timing

SMX3/21 will operate on a network of concatenated X.21 links. A facility is provided so that two co-located SMX3/21 (i.e. one at each end of separate X.21 links) units can be linked 'back to back'. This feature is referred to as Aggregate Concatenation. In this case the units may be configured so that the data on Channel A and / or Channel B is re-transmitted onto a second point to point link at the aggregate level via the Concatenation Port. For this to operate all links must be synchronised to the network master timing signal. If any link within the network is unsynchronised (e.g. a single radio link), SMX3/21 provides the option to output master network clock signals to otherwise unsynchronised links.

An alternative option is to concatenate a single data channel at V.24 level by daisy-chaining the V.24 data links. This is referred to as Data Channel Concatenation. In this case each X.21 link may be free-running (unsynchronised).

4. Equipment Layout



5. Channel Characteristics

The maximum bandwidth that may be configured for Data Channel A (X.21) is a function of the speed of the aggregate.

The sample rates for Aggregate Channels 2 & 3 are also a function of the aggregate speed; thus the maximum baud rate that can be configured for Data Channels B & C are a function of both the aggregate speed and the aggregate channel to which they are assigned. The range of baud rate settings remains the same regardless of aggregate speed.

Data Channel Aggregate Speed		64kbit/s	128kbit/s	192kbit/s	256kbit/s
Channel A (X.21)	Bandwidth kbit/s		64		64 or 128
Channel B or C (V.24) assigned to Agg. Ch 2	Sample Rate	16k	32k	48k	64k
	Baud Rate range (Async Mode)	1200 - 9600			
	Baud Rate range (Transparent Mode)	4800	9600	19200	38400
Channel B or C (V.24) assigned to Agg. Ch 3	Sample Rate	8k	16k	24k	32k
	Baud Rate range (Async Mode)	1200 - 4800	1200 - 9600		
	Baud Rate range (Transparent Mode)	2400	4800	9600	19200

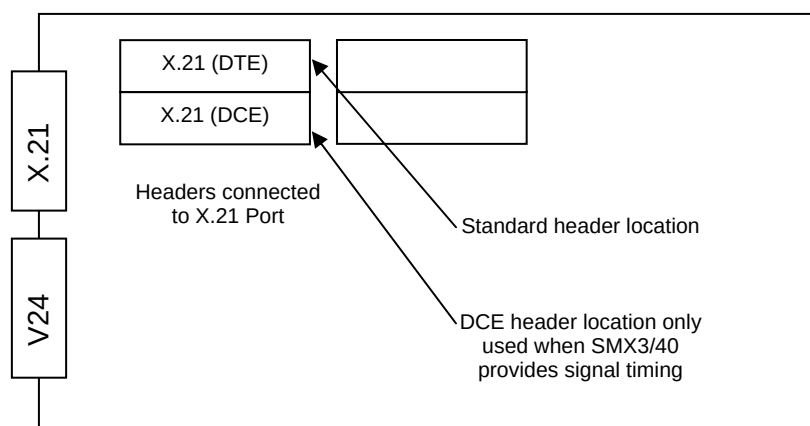
Transparent Mode is a high speed configuration for the V.24 ports particularly suited to applications for protection relays. The end to end delay in this mode is less than 0.5s (excluding delays introduced by the comms link).

6. X.21 Aggregate Port

The X.21 port is a DB15 male connector; this is connected internally to a header on the PCB using a ribbon cable. The X.21 port may be configured as DTE or DCE by fitting the ribbon cable to the appropriate X.21 Port Header, and by selecting settings on DIP switch 5. **Note: DTE is the standard configuration, and is used in all applications where the network provides the signal timing.**

Transceivers are specified to $\pm 15\text{kV}$ IEC1000-4-2 air discharge ESD protection and port connections are additionally protected by Tranzorb type arrays.

This port carries an aggregate of three bi-directional data channels; one X.21 channel and two V.24 channels.



X.21 header locations

Standard X.21 Port Pin-out (when in DTE configuration) – D15M on chassis					
Circuit		Pin A	Pin B	Direction	Notes
T	Transmit Data	2	9	Output	
R	Receive Data	4	11	Input	
C	Control	3	10	Output	Permanently on
I	Indication	5	12	Input	Signal ignored
S	Signal Element Timing	6	13	Input	Timing signal derived from the network
G	Ground	8	15		
X	Signal Element Timing	7	14	Output	Timing signal transmitted to network (X). Special applications only. Requires to be enabled using mode DTE + Timing X enabled
Screen / Drain					Must be earthed to shell

The DCE configuration may be used in specific circumstances where signal timing from the network timing is unavailable (e.g. when used with a radio link that does not provide a clock source). Two alternatives are:

The timing source is derived from a co-located unit that is itself deriving the master clock signal from the network. The two units are interconnected via the concatenation link (refer to following section. In this case Clock Source must be configured to Concat Port.

The timing source is derived from within the unit; in this case the Clock Source must be configured to Master.

In both cases the timing signal is output on pins 6 and 13.

Optional X.21 Port Pin-out (when in DCE configuration) – D15M on chassis					
Circuit		Pin A	Pin B	Direction	Notes
T	Transmit Data	2	9	Input	
R	Receive Data	4	11	Output	
C	Control	3	10	Input	Signal ignored
I	Indication	5	12	Output	Permanently on
S	Signal Element Timing	6	13	Output	Timing signal derived from the port and transmitted to network
G	Ground	8	15		
	Screen / Drain				Must be earthed to shell

In either configuration, use 6 pair plus ground stranded cable with overall shield (eg RS 111-8994).

Maximum recommended length in substations - 10m (Check Utility standards).

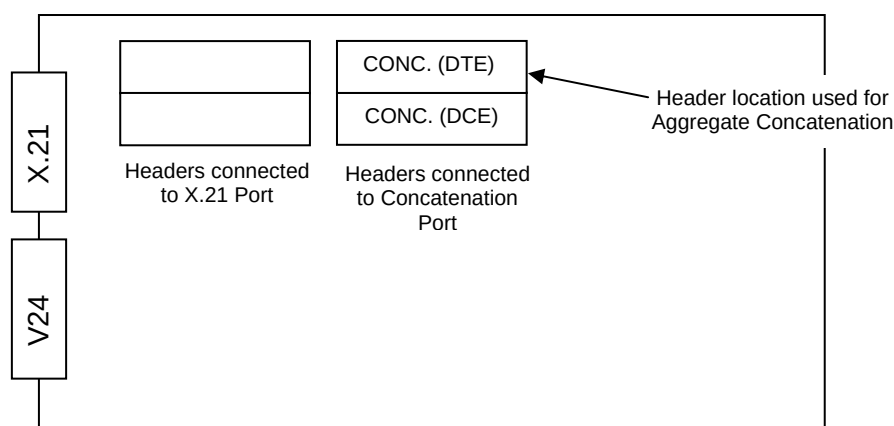
DIP switches provide configuration options, see section 10.

7. Concatenation Port

The Concatenation Port provides optional direct connection to a co-located SMX3/21 that is serving another X.21 link. Unless interrupted by a particular V.24 port setting, aggregate channel data passes between this port and the X.21 port. This port has the same capacity as the X.21 Port. Signal timing is always transferred across the Concatenation port when the port mode is set to 'Enabled as Concatenation'.

The Concatenation Port is a DB15 female connector; this is connected internally to a header on the PCB using a ribbon cable. The Concatenation Port may be configured as DTE or DCE by fitting the ribbon cable to the appropriate X.21 Port Header, and by selecting settings on DIP switch 5. **Note: DTE is the standard header location used for Aggregate Concatenation i.e. direct connection to a co-located SMX3/21.**

Transceivers are specified to $\pm 15\text{kV}$ IEC1000-4-2 air discharge ESD protection and port connections are additionally protected by Tranzorb type arrays.



Concatenation header locations

Aggregate Concatenation

Aggregate Concatenation is the interconnection at **aggregate** level of two co-located SMX3/21 units. For this function the Concatenation Port is configured as Enabled as Concatenation mode, (i.e. DTE with Timing X enabled). The timing signal is derived from the port and is transmitted on pins 7 and 14 (Xa and Xb).

In installations where the X.21 aggregate that is connected to each co-located unit receives timing from the network master clock, the clock source for both units should be configured as X.21 Port.

In installations where the X.21 aggregate that is connected to one or both co-located units do not receive timing from the network, the source of the timing signal must be determined and the clock source for each unit should be configured as X.21 Port, Concat Port or Master as appropriate (refer to DIP Switch 6 settings).

DIP switches provide configuration options, see section 10.

Standard Concatenation Port Pin-out (DTE configuration) as used for Aggregate Concatenation - D15F on chassis					
Circuit		Pin A	Pin B	Direction	Notes
T	Transmit Data	2	9	Output	
R	Receive Data	4	11	Input	
S	Signal Element Timing	6	13	Input	Timing signal derived from the network
G	Ground	8	15		
X	Signal Element Timing	7	14	Output	Timing signal derived from the port and transmitted to network.
C	Control	3	10	Output	Permanently on. Not used in Aggregate Concatenation
I	Indication	5	12	Input	Signal ignored. Not used in Aggregate Concatenation
	Screen / Drain				Must be earthed to shell

Aggregate Concatenation to a co-located SMX3/21 requires a five twisted pair cross-over cable with overall shield (eg RS 111-8988). Maximum recommended length 10m (check Utility standards).

Aggregate Concatenation Cable D15M – D15M			
Pair	Pin	End 1	End 2
1	A	2	4
	B	9	11
2	A	4	2
	B	11	9
3	A	6	7
	B	13	14
4	A	7	6
	B	14	13
5	A	8	8
	B	15	15
Screen / Drain		Must be earthed to connector shells at both ends	

The following table is for information only, and is not used in any standard configurations.

Optional Concatenation Port Pin-out (when in DCE configuration) – D15F on chassis					
Circuit		Pin A	Pin B	Direction	Notes
T	Transmit Data	2	9	Input	
R	Receive Data	4	11	Output	
C	Control	3	10	Input	Signal ignored
I	Indication	5	12	Output	Permanently on
S	Signal Element Timing	6	13	Output	Timing signal derived from the port and transmitted to network
G	Ground	8	15		
	Screen / Drain				Must be earthed to shell

8. X.21 Data Port (Channel A)

The port for Channel A is a DB15 female connector; it is configured as DCE.

Channel A Port Pin-out – D15F on chassis (DCE)					
Circuit		Pin A	Pin B	Direction	Notes
T	Transmit Data	2	9	Input	
R	Receive Data	4	11	Output	
C	Control	3	10	Input	see Note below
I	Indication	5	12	Output	See Note below
S	Signal Element Timing	6	13	Output	Timing signal transmitted to network
G	Ground	8	15		
	Screen / Drain				Must be earthed to shell

Transceivers are specified to $\pm 15\text{kV}$ IEC1000-4-2 air discharge ESD protection and port connections are additionally protected by Tranzorb type arrays.

Data received at the Channel A port is always terminated; it cannot be concatenated across the concatenation link.

S is normally synchronised to network timing but in the event of this being unavailable runs from an internal source within the SMX.

Note:

When DIP SW 1-2 is set to Local, I is ON when the channel is legally configured, the aggregate is running and in sync, in which case C is ignored

When DIP SW 1-2 is set to Remote, I is ON when the channel is legally configured, the aggregate is running and in sync, and C is received from the remote end.

9. V.24 Data Ports (Channels B & C)

Ports B and C are DCE ports on DB9 female connectors for asynchronous data:

Channels B & C Ports Pin-out – D9F on chassis (DCE)			
Circuit		Pin	Direction
TxD	Transmit Data	3	Input
RxD	Receive Data	2	Output
RTS	Request to Send	7	Input
CTS	Clear to Send	8	Output
DCD	Data Carrier Detect	1	Output
DTR	Data Terminal Ready	4	Input
DSR	Data Set Ready	6	Output
RI	Ring Indicator	9	Output
SG	Signal Ground	5	
Screen / Drain must be connected to the connector Shell			

RI is permanently OFF.

DSR is ON when aggregate framing is synchronised.

DTR is ignored.

RTS turns on remote DCD and local CTS after a delay.

Transceivers are specified to $\pm 15\text{kV}$ IEC1000-4-2 air discharge ESD protection and port connections are additionally protected by Tranzorb type arrays.

DIP switches provide configure options for each port, see section 10.

V.24 Port Sharing

There are two methods by which multiple V.24 ports can be assigned to an aggregate channel:

Channels (ports) B and C within an SMX3/21 unit are assignable to Aggregate Channels 2 and / or 3.

Where two SMX3s are co-located and interconnected via the concatenation ports, it is possible for each of Channels B & C to be selected to communicate over either via X.21 aggregate channel or the concatenation port in which cases the channel terminates within the SMX3/21, via both ports, for daisy-chain applications via a co-located SMX3/21.

Where multiple V.24 ports are assigned to a channel (on one or multiple SMX3/21 units), data from the channel is presented at RxD of all ports other than the source of the data, and data to the channel is an 'or' function of TxD of those ports where RTS is asserted ON. It is important therefore that equipment connected in this way, such as a SCADA system, has the self-discipline for only one to be transmitting at any time.

V.24 Data Channel Concatenation

SMX3/21 units co-located at one end of adjacent unsynchronised links may be concatenated at the V.24 level either through the connected equipment, or directly using a crossed RS232 data cable.

V.24 Port Performance

V.24 circuits operate to emulate a modem:

CTS follows the state of local RTS after any necessary delay, when the Aggregate is working and in synchronism.

DCD follows the state of remote RTS when the Aggregate is working and in synchronism.

DTR is ignored and can be left unconnected, the sub-multiplexer assumes a continuous ON state.

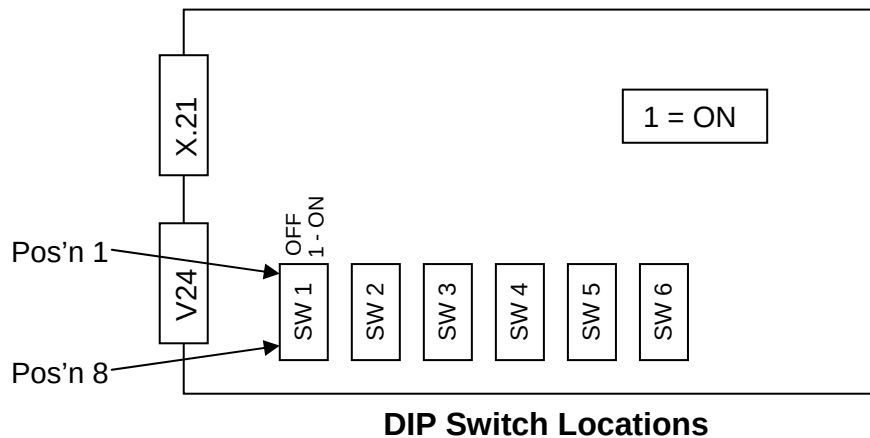
DSR is ON when the Aggregate is working and in synchronism.

RI is unconnected or permanently OFF.

When RTS turns ON, CTS turns ON when it can be assured that data presented at TxD will reach RxD at a remote end after DCD there has turned ON. This does not exceed 10 ms.

It is possible to configure each port to limit the duration of the effect of RTS to protect a SCADA system from an RTU which fails to turn RTS off after it has sent a response. When enabled, by DIP switch (SW 6-1 and 6-2), if RTS remains ON for longer than 2 seconds, its effect is terminated and its ON condition is not recognised again until it has been OFF for longer than 2 seconds.

10. DIP Switches



Dip Switch functions					
SW1	SW2	SW3	SW4	SW5	SW6
Channel A X.21 Data configuration	Channel B V.24 Data configuration	Channel C V.24 Data configuration	Not used	Aggregate & Concatenation enabling	Clock and Timing configuration

Setting data is in the following tables.

Refer to Section 14 for example configurations.

DIP Switch 1 settings:

SW 1 X.21 Data Channel A Configuration							
8	7	6	5	4	3	2	1
Bandwidth 00 = 64K 01 = 128K 10 = Not Used 11 = Not Used		Not Used	Always set to 0	Not Used	Local Loop 0= Off 1= On (Test only)	Indicate 0= Local 1= Remote (See Note Section 8)	Port Enable 0= Off 1= Enabled

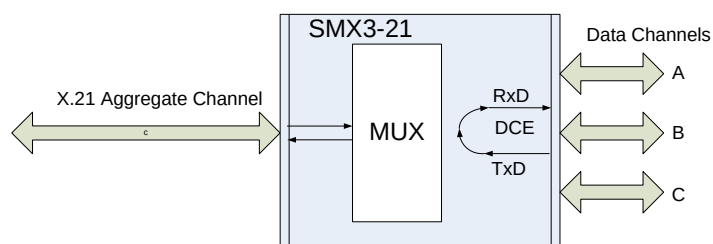
- Bandwidth

Set to 64kbit/s, or 128kbit/s if permitted by the speed of the aggregate (refer to table in section 5).

- Local Loop Off / On.

Normally set to Off

When set to On, data transmitted into of the MUX TxD is looped back to its RxD output. Channel A requires the clock to be present; as this is a DCE port the clock is sourced from the MUX; provided this is present local loop operation is always possible.



- Indicate

When set to Local, I is ON when the channel is legally configured, the aggregate is running and in sync, in which case C is ignored

When set to Remote, I is ON when the channel is legally configured, the aggregate is running and in sync, and C is received from the remote end.

- Channel Enable. Set to On to enable Channel A X.21 Data Channel

DIP Switch 2 – 3 settings:

SW 2 V.24 Data Channel B Configuration				SW3 – V.24 Channel C Configuration			
8	7	6	5	4	3	2	1
Baud Rate		Route		Mode		Agg Channel Assignment	
00 = 1200		00 = via X.21 Agg. Port		00 = Disabled		00 = Ch 2	
01 = 2400		01 = via Concat. Port		01 = Transparent		01 = Ch 3	
10 = 4800		10 = Both Ports		10 = Async 8 bit			
11 = 9600		11 = Local Loop		11 = Async 9 bit			

- Channel Allocation and Sharing: Select aggregate channel 2 or 3

Each V.24 Data Channel can be allocated to Aggregate Channel 2 or 3. More than one port may share a channel.

Where more than one Data Channel is allocated to the same Aggregate Channel, the ports share the aggregate channel. From the point of view of one of those ports, Transmit Data would be sent over the aggregate channel and to all other ports allocated to the same channel. Data from the aggregate channel or other such port(s) would appear as Received Data. This feature is useful for supporting SCADA systems where multiple terminals are attached, but they must be well disciplined where only one terminal transmits at once, waiting for CTS after asserting RTS.

- Mode: Disabled, Transparent, Async 8 bit, Async 9 bit.

Transparent is used where end-to-end delay is critical and may also be used for applications where asynchronous character formats are not specifically supported. The baud rate settings are ignored. (See section 5)

Async 8 bit is selected for: 7 data bits plus 1 parity bit (even or odd).

or: 8 data bits plus 0 parity bit.

Async 9 bit is selected for: 8 data bits plus 1 parity bit (even or odd).

- Route: X.21 Port, Concatenation Port, Both Ports.

If X.21 Port is selected, traffic on the allocated aggregate channel terminates at this port. That channel is then available for other traffic over the Concatenation Port.

If Concatenation Port is selected, data on the selected aggregate channel terminates at this port and that channel is available for other data over the aggregate.

If Both is selected, traffic on the selected aggregate channel between X.21 Port and Concatenation Port appears at RxD as an 'or' of data from either direction, and TxD is sent in both directions. This mode is suitable only for a well-disciplined system (where only one terminal transmits at once), waiting for CTS after asserting RTS.

Local Loop operates as described for DIP Switch 1

As channels B and C are asynchronous there is no requirement for a network clock.

- Baud Rate: 1200, 2400, 4800, 9600 bits/sec.

When Async 8 or Async 9 mode is selected, set the baud rate to match the connected equipment. 9600 bits/s requires allocation to a 32kHz sampling channel.

Do not set different baud rates for ports allocated to the same aggregate channel.

DIP Switch 5 settings:

Switch 5 – X.21 Aggregate Channel and Concatenation Channel Enabling							
8	7	6	5	4	3	2	1
Concatenation Port				X.21 Port			
Local Loop 0 = Off 1 = On (Test only)	Spare	Mode 00 = Disabled 01 = Enabled as DTE 10 = Enabled as DCE 11 = Enabled as Concat		Local Loop 0 = Off 1 = On (Test only)	Spare	Mode 00 = Disabled 01 = Enabled as DTE 10 = Enabled as DCE 11 = Not used	

- Mode: Disabled, Enabled as DTE, Enabled as DCE, Enabled as Concat (ie DTE + Timing Signal X)

Enabled as DTE. This is the normal setting for the X.21 Port when connecting to X.21 links carrying network master clock timing (eg BT Kilostream)

Enabled as DCE. This optional setting is used when the X.21 link requires to be synchronised to the network master clock signal received from a co-located SMX3/21, (or to itself as master where network timing is unavailable). The timing signal X is output on pins 6 and 13 (Sa and Sb). Timing must be selected

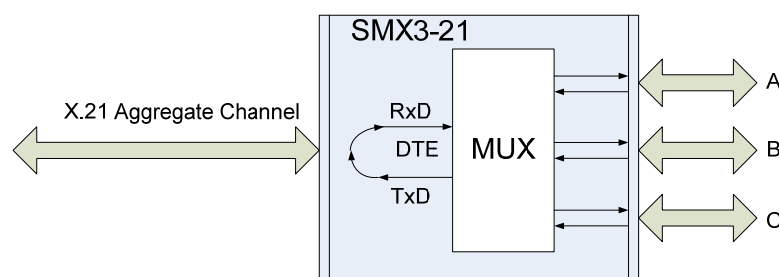
Enabled as Concat (ie DTE + Timing X). This is the normal setting for the Concatenation Port when connecting to a co-located SMX3/21 using the Aggregate Concatenation facility. The timing signal X is output on pins 7 and 14 (Xa and Xb).

- Local Loop: Off / On
Normally set to Off.

When set to On, data transmitted out of the MUX on the aggregate is looped back to its Receive input. The clock is required for this to function.

The method of operation is the same for the X.21 Aggregate Port and for the Concatenation Port.

- In DTE mode (normal operation) the clock is sourced from the network, so the network connection must be present for the local loop to operate.
- In DCE mode the clock is sourced from the MUX so the local loop works independently of the network connection.
- In Concatenation mode the clock is sourced from the unit at the opposite end of the link, so an SMX3/21 must be present at each end of the concatenation link.



DIP Switch 6 settings:

Switch 6 – Clock and Timing Configuration							
8	7	6	5	4	3	2	1
Aggregate Speed kbit/s		Clock Source		Not Used		RTS Time Out	
00 = 64		00 = X.21 Port				Port C 0 = Disabled 1 = Enabled	Port B 0 = Disabled 1 = Enabled
01 = 128		01 = Concat port					
10 = 192		10 = Master					
11 = 256		11 = Auto					

- V.24 Port RTS Timeout:

Normally set to Enabled for a polling system.

When Enabled, the effect of RTS ON is limited to 2 seconds, i.e. CTS and remote DCD turn OFF and TxD is blocked. In order to recover, RTS presented to the port has to turn off and remain off for 2 seconds. This feature is to prevent a faulty RTU of a SCADA system from interfering with traffic on the rest of the SCADA system.

Do not set to Enabled when port is dedicated for use with MPR or other protection relay, or when testing with a data tester.

- Timing source: X.21 Port, Concatenation Port, Master, Auto,

X.21 is the normal setting for applications where the SMX3/21 X.21 port is connected to a service synchronised with the network master clock.

Concatenation Port is the setting used when an X.21 link needs to be synchronised to the network master clock signal from an **adjacent** link. Signal timing is via the concatenation port from the co-located unit. When used in conjunction with the modes Enabled as DCE, (or Enabled as DTE + Signal Timing X), the timing signal received from the concatenation port will be output onto the X.21port.

Master is used where it is necessary for timing to be generated internally for SMX/21. The clock is generated internally and transmitted on X on either the X.21 Aggregate port or the Concatenation port. It is used with Enabled as DCE mode, (generally for test purposes only), and for Enabled as Concat mode where two units are interconnected via concatenation ports and the X.21 network service is unavailable.

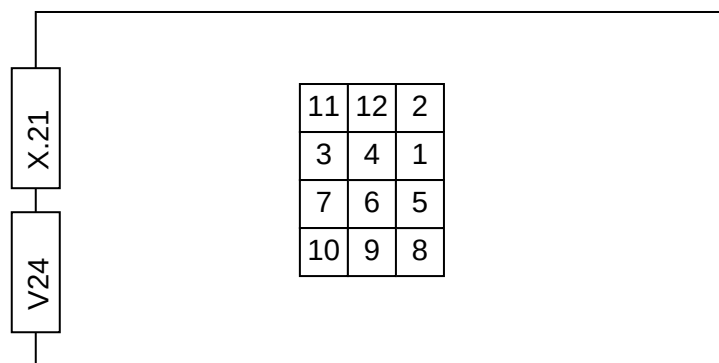
Auto locks timing to the X.21 port as a priority and to the Concatenation port if that fails. When timing is locked to the Concatenation port and an acceptable clock appears on the X.21 port, timing source will revert to the X.21 port. This function has a special application for East-West applications where both X.21 and Concatenation ports receive network master clock timing. This is not used when concatenating consecutive point to point links using the concatenation port to connect to an co-located SMX3/21.

- Aggregate Speed: 64, 126, 192, 256 kbits/s

Set to match the network clock speed. For X.21 networks operating at n = 1, set to 64kbits/s. (Note: when using Channel A (X.21 port), it is not possible to use 64 or 192kbits/s, but it is possible to use the V.24 ports alone)

11. LEDs

12 LEDs are located in the centre of the board for connection via flexible light pipes to display locations. See equipment layout.



LED	Colour	Function
1	Green	Power input 1
2	Green	Power input 2 (only where applicable)
3	Green	X.21 Data Port A Transmitting data
4	Green	X.21 Data Port A Receiving data
5	-	Not used
6	-	Not used
7	Green	V.24 Port B Transmitting data
8	Green	V.24 Port B Receiving data
9	Green	V.24 Port C Transmitting data
10	Green	V.24 Port C Receiving data
11	Red/Green	X.21 Agg. channel – see following table
12	Red/Green	Concatenation channel – see following table

Note: For units connected in a concatenated network, data on aggregate channels 2 and 3 is broadcast to all configured V.24 ports regardless of whether there is equipment connected to those ports. In these cases Channel B and C Rx LEDs (viz. data being transmitted from a DCE port) will signal green as traffic is carried.

LEDs 11 & 12 illuminate according to equipment and aggregate status on the associated port. When communications are healthy, the LED should be solid green for an enabled port.

X.21 Aggregate and Concatenation LED status	
Display	Condition
Off	Port disabled
Fast flash (3/s)	Configuration error
Slow flash (1/s)	No clock present
Steady	Bit timing locked to Master Clock - Healthy
Red	Aggregate frame not synchronised
Green	Aggregate frame synchronised - Healthy
Yellow	Yellow alarm (remote alarm)

12. Power Input

Power input is 48 Vdc nominal. (24V – 72V range).

SMX3/21 can be connected to positive earth, negative earth or floating supplies.

The power connections P1 and P2 are not polarity sensitive, but when using a grounded supply, the 0V leg must be connected to P2. (See table)

A 500mA fuse (5 x 20mm) is in the rail connected to the P1 terminal.

A separate earth connection is required to the M4 Earth stud provided.

Power Input Connections			
Type of supply	Terminal P1	Terminal P2	Earth stud
Positive Earth	– 48Vdc	0V	Main Earth
Negative Earth	+48Vdc	0V	Main Earth
Floating	Either	Either	Main Earth

13. Alarms

Two alarm relays are incorporated, energised when healthy. Each relay provides a single changeover contact presented on a plug-in terminal strip, see equipment layout. For a contact that closes on alarm, use common and NC connections.

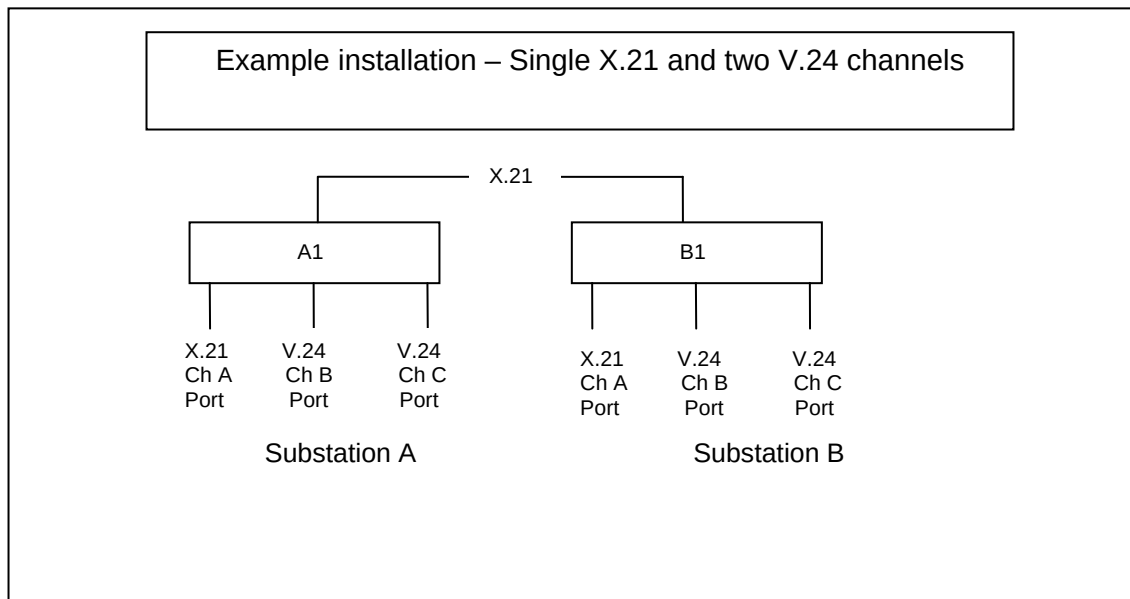
- Power alarm:
Energised when healthy
Alarm state is when applied voltage falls below nominal minimum voltage.
- Aggregate communications alarm:
Alarm state is when any of the following conditions are present on either the X.21 or Concatenation ports (only when enabled):
 - Aggregate port configuration error
 - No clock present
 - Aggregate frame not synchronised
 - Yellow alarm (remote alarm)

Alarm Connections			
Function	Terminal	Contact	Notes
Aggregate Comms Alarm	A	NC	Closed in alarm state
	B	Common	
	C	NO	Closed when healthy
Power Alarm	D	NC	Closed in alarm state
	E	Common	
	F	NO	Closed when healthy

14. Example Configurations

Example 1: X.21 synchronous data point to point and two channels of V.24 asynchronous data point to point.

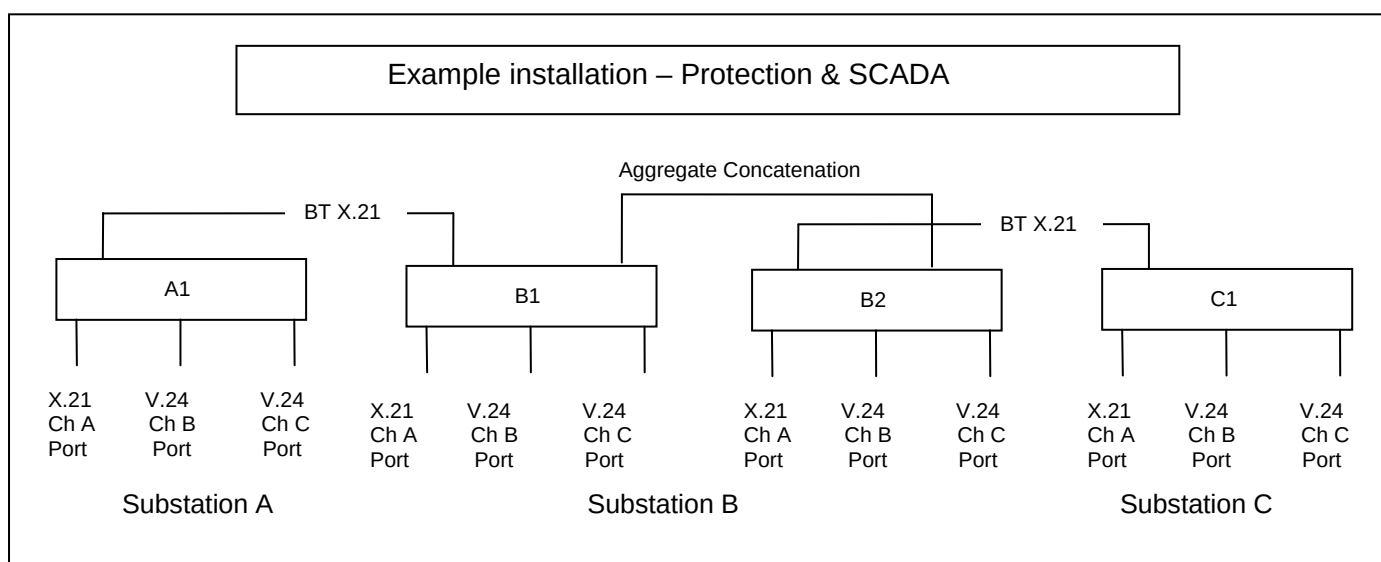
This configuration assumes a master clock signal is provided by the X.21 links. V.24 channels configured in Transparent mode.



DIP Switch Settings for both units								
	8	7	6	5	4	3	2	1
SW1	0	0	0	0	0	0	0	1
SW2	0	0	0	0	0	1	0	0
SW3	0	0	0	0	0	1	0	1
SW4	Not used							
SW5	0	0	0	0	0	0	0	1
SW6	0	1	0	0	0	0	0	0

Example 2: X.21 synchronous data links point to point, and two V.24 channels concatenated over two links (e.g. X.21 protection relays and SCADA network on two BT kilostream X.21 links):

Only possible on a well disciplined system, where only one terminal transmits at one time. This configuration assumes that both X.21 links are running on the same network master clock e.g. BT Kilostream. V.24 channels configured in Transparent mode.



DIP Switch Settings for A1, C1								
	8	7	6	5	4	3	2	1
SW1	0	0	0	0	0	0	0	1
SW2	0	0	0	0	0	1	0	0
SW3	0	0	0	0	0	1	0	1
SW4	Not used							
SW5	0	0	0	0	0	0	0	1
SW6	0	1	0	0	0	0	0	0

DIP Switch Settings for units B1, B2								
	8	7	6	5	4	3	2	1
SW1	0	0	0	0	0	0	0	1
SW2	0	0	1	0	0	1	0	0
SW3	0	0	1	0	0	1	0	1
SW4	Not used							
SW5	0	1	1	0	0	0	0	1
SW6	0	1	0	0	0	0	0	0

15. Blank Setting Table

Blank setting table:

Location:								
Reference:								
DIP Switch Settings								
	8	7	6	5	4	3	2	1
SW1								
SW2								
SW3								
SW4								
SW5								
SW6								

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RFL Communications plc
Connect 17
Avon Way
Langley park
CHIPPENHAM
Wilts
SN15 1GG

www.rflcomms.co.uk

Installation and Technical Support:
Phone +44 (0) 1249 446500
Fax +44 (0) 1249 446506

e-mail support@rflcomms.co.uk